

Table 1. Bird carcasses recovered in the aftermath of the Tenyo Maru oil spill.

<b>Species</b>	<b>Number Recovered</b>	<b>Percent of Total</b>
Common Murre	3157	73.3
Rhinoceros Auklet	281	6.5
Tufted Puffin	127	2.9
Cassin's Auklet	116	2.7
Western/Glaucous-winged Gull	91	2.1
California Gull	87	2.0
Northern Fulmar	67	1.6
Unidentified bird	54	1.2
Sooty Shearwater	49	1.1
Marbled Murrelet	45	1.0
White-winged Scoter	41	<1.0
Unidentified Gull	39	<1.0
Pigeon Guillemot	33	<1.0
Caspian Tern	25	<1.0
Pelagic Cormorant	18	<0.5
Unidentified Cormorant	12	<0.5
Black-footed Albatross	11	<0.5
Brandt's Cormorant	10	<0.5
Surf Scoter	10	<0.5
Short-tailed Shearwater	5	<0.5
Double-crested Cormorant	5	<0.5
Mew Gull	4	<0.01
Western Grebe	2	<0.01
Common Loon	1	<0.01
Red-throated Loon	1	<0.01
Unidentified Shearwater	1	<0.01
Fork-tailed Storm-petrel	1	<0.01
Leach's Storm-petrel	1	<0.01
Unidentified Storm-petrel	1	<0.01
Bufflehead	1	<0.01
Black Turnstone	1	<0.01
Arctic Tern	1	<0.01
Horned Puffin	1	<0.01
Crow spp.	1	<0.01

Table 2. Species list of marine birds nesting at Point Grenville, Tatoosh Island, and Yaquina Head.

<b>Species</b>	<b>Pt Grenville</b>	<b>Tatoosh</b>	<b>Yaquina</b>
Common Murre	x	x	x
Glaucous-winged Gull	x	x	
Western Gull			x
Double-crested Cormorant	x	x	
Brandt's Cormorant			x
Pelagic Cormorant	x	x	x
Rhinoceros Auklet		x	
Cassin's Auklet		x	
Leach's Storm-Petrel	x <sup>2</sup>	x	
Fork-tailed Storm-Petrel		x	
Pigeon Guillemot	x	x	x
Tufted Puffin	x	x	
Black Oystercatcher <sup>1</sup>	x <sup>2</sup>	x	

<sup>1</sup> Black Oystercatchers are not considered seabirds in this report.

<sup>2</sup> Neither Leach's Storm-Petrels nor Black Oystercatcher were confirmed nesting during 2001 or 2002.

Table 3. Personnel and effort at Point Grenville and Tatoosh in 2001 and 2002.

Colony	Personnel	Dates		# person days		Total observation hours	
		2001	2002	2001	2002	2001	2002
<i>Point Grenville</i>	Stephani Zador Dan Nelson Dan Davis	June 6 – Aug 27	Jun 12 – Sep 4	110	114	165	243
<i>Tatoosh Island</i>	Julia Parrish Nathalie Hamel Colin French Erin Hagen	May 23 – Aug 17	May 23 – Aug 16	105	84	252	280

Table 4. At-sea murre population sampling design overview

Researcher and Recovery Zone	MR/CT (1)	CT (2)
Target Population	Near shore marine waters of Zones 1	Near shore marine waters of Zones 2
Geographic Strata	1. Strait of Juan de Fuca 2. San Juan Islands and selected portions of Puget Sound 3. The remainder of San Juan Islands and Puget Sound	1. WA North Coast 2. WA South Coast 3. Grays Harbor, Willapa Bay and Columbia River
Primary Sampling Unit (PSU <sup>1</sup> )	~20 km section of coast line with inshore and offshore subunits	
Offshore PSU Subunit Boundaries by Geographic Stratum	1. 350-1500m/1500-4950m 2. 150-500m/500-1950m 3. 150-1950m	1. 350-1500m/1500-4950m 2. 350- 1500m/1500-7950m
Area of Inference by Geographic Stratum	1. 300-5000m 2. 100-2000m 3. 100-2000m	1. 300-5000m 2. 300-8000m
PSU Selection	Random selection without replacement within each geographic stratum and spread over time and space to the maximum extent feasible logistically	
Total PSUs (and per Geographic Stratum)	Total PSUs = 98 Stratum 1 = 9 Stratum 2 = 42 Stratum 3 = 47	Total PSUs = 17 Stratum 1 = 8 Stratum 2 = 6 Stratum 3 = 3
Sample Size of PSUs in 2000 (and per Geographic Stratum)	Total = 31 Stratum 1 = 6 Stratum 2 = 20 Stratum 3 = 5	Total = 16 Stratum 1 = 8 Stratum 2 = 6 Stratum 3 = 0
Area of Zone Km <sup>2</sup> (and per Stratum)	Total = 3,519 Stratum 1 = 742 Stratum 2 = 1,239 Stratum 3 = 1,538	Total = 1,621 Stratum 1 = 648 Stratum 2 = 973 Stratum 3 = ??
Time of Year	Mid-May to mid-July	Mid-May to end of July
PSU Subsampling	Four 5-Km parallel transects in inshore subunit, parallel and zigzag offshore	Four 5-Km parallel transects in near shore subunit, zigzag offshore

<sup>1</sup> PSU = Primary Sampling Unit, explained further below.

MR = Martin Raphael, FS PNW

CT = Chris Thompson, WDFW

Table 5. Numbers of adult murres counted at Point Grenville in 2001 and 2002. All observations were made from land-based points on Point Grenville and Grenville Bay beach. Murres were counted between the beginning of the egg stage and before chicks began to fledge, unless noted otherwise. Count samples sizes are in parentheses and include only those made during good visibility. Means are reported  $\pm 1$  S.E.

<b>Rocks</b>	<b>Subcolonies (#)</b>	<b>2001</b>		<b>2002</b>	
		<b>Average</b>	<b>Maximum</b>	<b>Average</b>	<b>Maximum</b>
Grenville Arch	5	35 $\pm$ 6 (27)	130	41 $\pm$ 6 (22) <sup>1</sup>	94
Erin's Bride	3	24 $\pm$ 3 (28)	54	60 $\pm$ 4 (28)	113
Erin	12	58 $\pm$ 8 (25)	149	115 $\pm$ 7 (26)	200
Grenville Pillar	3				
	CT	15 $\pm$ 2 (13)	22	13 $\pm$ 1 (46)	27
	PC	13 $\pm$ 2 (12)	20	4 $\pm$ 1 (42)	22
	SP	42 $\pm$ 6 (10)	72	26 $\pm$ 3 (42)	60

<sup>1</sup> Counts include only those taken before the rock was essentially abandoned (24 July).

Table 6. Numbers of adult murres counted at Tatoosh in 2001 and 2002. Means are reported  $\pm$  1 S.E.

Subcolony	2001				2002			
	<i>Morning</i>		<i>Afternoon</i>		<i>Morning</i>		<i>Afternoon</i>	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Crisscross 1	37.6 $\pm$ 0.66 (18)	44	41.9 $\pm$ 1.23 (14)	48	34.9 $\pm$ 1.69 (11)	43	39.5 $\pm$ 1.48 (2)	41
Crisscross 2	49.3 $\pm$ 1.01 (18)	57	58 $\pm$ 2.16 (14)	72	42.5 $\pm$ 2.14 (11)	54	53 $\pm$ 4.03 (2)	57
Crisscross 3	44.7 $\pm$ 1.08 (18)	55	51 $\pm$ 1.63 (14)	61	43 $\pm$ 1.57 (11)	51	54 $\pm$ 4.03 (2)	58
Crisscross 4	16.7 $\pm$ 0.68 (18)	23	17.7 $\pm$ 0.91 (14)	21	12.8 $\pm$ 0.93 (11)	18	16.5 $\pm$ 0.49 (2)	17
Crisscross 5	108.2 $\pm$ 1.79 (18)	124	122.6 $\pm$ 3.13 (14)	143	91.5 $\pm$ 4.37 (11)	113	111 $\pm$ 7.00 (2)	118
Tenniscourt 1	32.4 $\pm$ 0.71 (18)	38	39.6 $\pm$ 1.66 (14)	55	30.8 $\pm$ 1.24 (11)	36	38 $\pm$ 0.99 (2)	39
Tenniscourt 2	22.6 $\pm$ 0.42 (18)	26	25.1 $\pm$ 0.78 (14)	29	19.7 $\pm$ 0.84 (11)	24	24.5 $\pm$ 1.48 (2)	26
Tenniscourt 3	85.6 $\pm$ 1.03 (18)	92	101.3 $\pm$ 3.02 (14)	119	80.8 $\pm$ 3.31 (11)	96	97 $\pm$ 2.97 (2)	100
Tenniscourt 4	34 $\pm$ 0.92 (18)	38	38.9 $\pm$ 0.99 (14)	45	30 $\pm$ 1.96 (11)	44	33 $\pm$ 0 (2)	33

*Attendance data: 2001 from 11 June through 8 Aug, 2002 from 12 June through 6 Aug*

*Morning:afternoon cut-off: 2001 1500H, 2002 1400H*

*2002: The counts for CC1, 4, and 5 are lower than in Table 1 because none of these crevices were entirely visible from BBPT*

Table 7. Estimate of the number of murres in the nearshore waters ( $\leq 8$  km from shore) of the outer coast of Washington in summer (15 May – 31 July) in 2001 and 2002.

<b>Year</b>	<b>Zone</b>	<b>Stratum</b>	<b>Density</b>	<b>S.E. (density)</b>	<b>S.E. (density as % of estimate)</b>	<b>Birds</b>	<b>Lower 95% CL</b>	<b>Upper 95% CL</b>	<b>Area</b>
2001	2	1	55.74	12.03	21.6%	40,523	21,476	56,053	726.972
2001	2	2	33.63	7.99	23.7%	32,317	18,537	41,820	960.889
2001	2	All	43.16	6.75	15.6%	72,840	48,816	91,124	1,687.860
2002	2	1	54.74	12.40	22.6%	39,795	24,771	59,887	726.972
2002	2	2	35.61	17.14	48.1%	34,216	2,996	54,307	960.889
2002	2	All	43.85	11.08	25.3%	74,011	35,803	103,048	1,687.860

Table 8. Summary of murre phenology data from Point Grenville in 2001 and 2002. Median and ranges are reported for those subcolonies in which detailed observations were possible. Dates in parentheses represent phenology of replacement clutches.

		2001			2002		
		Laying	Hatching	Fledging	Laying	Hatching	Fledging
Grenville Arch							
Erin's Bride					<6/13<?	<7/26	>8/5
Erin		<6/14<?			<6/13<?	<7/29	>8/5
Grenville Pillar							
CT	median	6/12	7/14	8/4	6/17 (7/9)	(8/10)	
	range	6/11-7/8	7/13-8/9	7/30-8/27	6/13-6/20 (7/7-7/20)	(8/6-8/20)	(>8/28)
PC	median	6/16	7/18	8/11	(7/10)		
	range	6/12-7/10	7/14-8/11	8/8-8/27			
SP		<6/28<	<8/15<	>8/27			



Table 9. Summary of murre phenology data from Tatoosh in 2001 and 2002. Both ranges of the middle 50% and all (reported as 'range') nests are presented when known.

		2001			2002		
Plot		Laying	Hatching	Fledging	Laying	Hatching	Fledging
MCT-EXT#1	mid 50% range	6/21-27 6/11-≤7/9	7/26-28 ≤7/23-8/16	8/16-20 7/7-≥8/17	6/19-28	7/21-8/1	8/13-21
MCT-EXT#2	mid 50% range	6/21-26 6/11-≤7/25	7/23-29 ≤7/23-8/13	N/A 8/9-≥8/17			
PC1	mid 50% range				6/10-14 ≤6/10-≤7/8	7/12-17 7/9-8/5	8/5-10 ≤8/2-≥8/16
PC2	mid 50% range	6/10-13 ≤6/11-≤7/8	7/13-16 7/8-8/3	8/7-11 8/4-≥8/17	6/8-13	7/13-16	8/5-9

Table 10. Summary of murre productivity data from Point Grenville in 2001 and 2002. Data are presented for each rock, as well as observable sub-colonies on Grenville Pillar.

<b>Rocks</b>	<b>2001</b>			<b>2002</b>		
	<b>Eggs seen<sup>1</sup></b>	<b>Chicks seen</b>	<b>Chicks fledged<sup>2</sup></b>	<b>Eggs seen<sup>3</sup></b>	<b>Chicks seen</b>	<b>Chicks fledged<sup>4</sup></b>
Grenville Arch	0	0	None assumed	0	1	1
Erin's Bride	0	0	None assumed	0	19	19
Erin	12	0	None assumed	0	26	26
Grenville Pillar						
CT	10	10	10	8	6	6
PC	6	6	5	2	0	0
SP	7+	11	Some assumed	11	4	4

<sup>1</sup> Any early egg loss may have gone unobserved because observations at Grenville Pillar began when murres were already incubating eggs.

<sup>2</sup> One chick at Grenville Pillar disappeared when 14 days old, which we consider too young to assume it fledged successfully.

<sup>3</sup> Data are numbers of sites with eggs and do not include replacement eggs.

<sup>4</sup> We assume any chick visible on Erin's Bride and Erin is old enough to have fledged successfully.

Table 11. Detailed productivity data for subcolonies on Erin's Bride and Erin as observed from Grenville Bay beach in 2002.

<b>Rock</b>	<b>Plot</b>	<b>Estimated breeding sites<sup>1</sup></b>	<b>Minimum chicks produced<sup>2</sup></b>	<b>% Success<sup>5</sup></b>	<b>Date first chick seen</b>	<b>Date first chick fledged<sup>3</sup></b>	<b>Date plot vacated</b>
Erin's Bride	A	9	7	78	8/6	8/6	8/22
	B	8	7	88	7/29	8/7	8/22
	DI	9	5	56	7/26	8/7	>8/22
Erin	C	23	16	70	7/29	8/6	>8/22
	D	2	1	50	8/8		8/14
	DC <sup>4</sup>	0	0				7/24
	E	3	0				8/19
	F	2	1	50	7/29	8/7	8/21
	G	5	2	40	7/29		8/21
	H	5	4	80	7/29	8/6	8/16
	I	2	0	0			8/22
	J	4	1	25	8/5	8/10	8/19
	K	2	1	50	8/10		8/21
	L	0	0				7/2
	M	0	0				Never attended
Totals		74	45				
Plot-wise <sup>6</sup>				61			
Pair-wise <sup>7</sup>				53			

<sup>1</sup> Data are the minimum constant number of murres counted in these plots during the egg and chick period (6/13-8/6). Most of the plots likely contain breeding sites that we could not observe from the beach.

<sup>2</sup> We assume any chick visible to observers on the beach is old enough to have fledged successfully.

<sup>3</sup> We do not report fledging dates for chicks observed only once.

<sup>4</sup> Pelicans appeared to displace murres from this plot. See Results.

<sup>5</sup> % Success equals # of chicks produced, divided by # of breeding sites, for a subcolony; total value is total chicks/total sites.

<sup>6</sup> Average across all subcolonies.

<sup>7</sup> Average across all pairs.

Table 12. Summary of murre productivity data from Tatoosh Island in 2001 and 2002. Values in % success are (chicks fledged or  $\geq 12$  days old<sup>1</sup> when last observed) for each subcolony.

<b>Subcolony</b>	<b>2001</b>			<b>2002</b>		
	<b>Pairs</b>	<b>Chicks</b>	<b>% Success</b>	<b>Pairs</b>	<b>Chicks</b>	<b>% Success</b>
MCT-EXT	166	134	81	82	69	84
PC	95	69	73	192	121	63
CC1	22	19	86	23	19	83
CC2L	27	19	70	24	22	92
CC3	34	32	94	32	25	78
CC4	8	6	75	9	8	89
Totals	352	279		362	264	
Plot-wise <sup>2</sup>			80			81
Pair-wise <sup>3</sup>			79			73
Pole Island <sup>4</sup>			60			30
Islandwide <sup>5</sup>			77			71

<sup>1</sup> This relaxed definition was used because logistical constraints precluded island visitation during fledging of cliff-top subcolonies. However, chicks reaching 12 days almost always fledge on these plots (Parrish unpub. data).

<sup>2</sup> Average across all subcolonies.

<sup>3</sup> Average across all pairs.

<sup>4</sup> Reproductive success estimated based on late season counts of chicks in attendance plot (roughly one third of all murre on the subcolony).

<sup>5</sup> See text for calculation details.

Table 13. Percent composition of fish delivered to chicks at Point Grenville and Tatoosh in 2001 and 2002. Data in **bold type** represent fish that comprised >5% of the diets in either year at both colonies (with the exception of myctophids, which are observed only at Tatoosh).

Fish	<u>Pt Grenville</u>		<u>Tatoosh</u>	
	2001	2002	2001	2002
<b>Smelts</b>	<b>53.4</b>	<b>45.3</b>	<b>37.6</b>	<b>43.1</b>
<i>Surf Smelt</i>	32.9	5.0	32.1	35.0
<i>Eulachon</i>			4.8	7.2
<i>Long-Finned Smelt</i>			0.3	0.2
<i>Top Smelt</i>			0.2	
<i>Unidentified Smelt</i>	19.5	40.3	0.2	0.7
<b>Herring</b>	<b>30.5</b>	<b>14.3</b>	<b>35.4</b>	<b>19.7</b>
<b>Sandlance</b>	<b>3.7</b>	<b>28.6</b>	<b>11.4</b>	<b>8.3</b>
<b>Myctophids</b>			<b>6.7</b>	<b>11.6</b>
<b>Salmon</b>	<b>12.2</b>	<b>3.4</b>	<b>0.5</b>	<b>6.6</b>
Gadids	1.2	7.6	2.0	1.2
Rockfish			1.4	1.9
Pacific Sandfish			0.9	1.1
Hexagrammids		0.8	0.3	
Squid			0.3	0.7
Larval Fish			0.3	0.1
Flatfish			0.2	0.1
Sculpins			0.1	
Ratfish				0.1
Unidentified			3.0	5.5
<b>Total species</b>	<b>5</b>	<b>6</b>	<b>16</b>	<b>14</b>
<b>Total fish</b>	<b>82</b>	<b>119</b>	<b>1743</b>	<b>1602</b>

Table 14. Chick feeding rates at Point Grenville and Tatoosh in 2001 and 2002. Rates are presented as the hourly averages during 5 time periods (with starting times for 1 = 0500-0730; 2=0730-1030; 3=1030-1330; 4=1330-1630; 5=1630-1930). Watches were 0.75 - 1.5 hours in length.

	<b>Point Grenville</b>		<b>Tatoosh</b>	
	<b>2001</b>	<b>2002</b>	<b>2001</b>	<b>2002</b>
Fish/hour (n = 5 time blocks)	0.36 ± 0.03	0.37 ± 0.05	0.28 ± 0.02	0.24 ± 0.03
Hours/fish	2.8	2.7	3.6	4.2
Fish/day (assuming 16 hr day)	5.8	5.9	4.5	3.8
# pairs watched	1-9	5-6	15-65	10-56
Total hours of watches	99	41	104	77

Table 15. Percent of time during an 8-hour watch that both adults attended nest sites. Fish per day are based on actual day length from U.S. Navy tables, ([http://mach.usno.navy.mil/cgi-bin/aa\\_rstablew.pl](http://mach.usno.navy.mil/cgi-bin/aa_rstablew.pl)). Watches were conducted during the mid and late chick rearing stages at Point Grenville (20, 27 Aug), Tatoosh (23, 28 July), and Yaquina (26 June, 1 July). Median chick age was 12 days during the mid chick rearing watch and 17 days during the late chick rearing watch. The same nests were observed during each watch (Point Grenville n = 6 nests, Tatoosh n = 12 nests, Yaquina = 14 nests).

Colony/Observation Period	Mid chick rearing		Late chick rearing	
	Hourly chick feeding rates	Fish/day	Hourly chick feeding rates	Fish/day
<i>Pt Grenville</i>				
1-4	0.25 ± 0.11		0.21 ± 0.08	
5-8	0.13 ± 0.06		0.13 ± 0.06	
1-8	0.19 ± 0.08	2.7	0.17 ± 0.04	2.3
<i>Tatoosh</i>				
1-4	0.25 ± 0.07		0.27 ± 0.06	
5-8	0.17 ± 0.04		0.10 ± 0.05	
1-8	0.21 ± 0.04	3.2	0.21 ± 0.04	3.2
<i>Yaquina</i>				
1-4	0.07 ± 0.04		0.29 ± 0.05	
5-8	0.14 ± 0.04		0.18 ± 0.06	
1-8	0.11 ± 0.03	1.7	0.23 ± 0.05	3.6

Table 16. Measures of bald eagle activity near the murre colonies at Point Grenville and Tatoosh in 2001 and 2002.

Activity	Pt Grenville		Tatoosh	
	2001	2002	2001	2002
Murres killed by eagles during breeding stages: <sup>1</sup>				
Pre-lay	0	0	1	0
Egg	1	0	5	11
Chick	0	0	1	0
Fledging	0	0	0	0
Fly-by rate	N/A	0.28 fb/hr	??? fb/hr	??? fb/hr
Eyries within 24 km	12 (7 successful) <sup>2</sup>	11 (9 successful) <sup>2</sup>	24 (13 successful)	19 (15 successful)
Max number of eagles per day:	0.85±0.15	1.35±0.23	N/A	N/A
< 20 July	(n=55 days)	(n=57 days)		
	1.24±0.24	2.08±0.42	N/A	N/A
	(n=29 days)	(n=26 days)		
≥ 20 July	0.42±0.14	0.74±0.15	N/A	N/A
	(n=26 days)	(n=31 days)		
Max number of eagles per trip	1.93±0.40	2.86±0.62	5.38±0.96 (n=8 trips)	6.71±2.24 (n=7 trips)
Observation days	55	57	38 (rtp)	30 (rtp)
Observation hrs:				
< 20 July	81	106	29 <sup>4</sup>	13 <sup>4</sup>
≥ 20 July	84	137	14 <sup>4</sup>	15 <sup>4</sup>

<sup>1</sup> The beginning of a stage is defined by the first event of that stage (e.g., the egg stage begins when the first egg is laid)

<sup>2</sup> Draft data provided from the Quinault Indian Nation.

<sup>3</sup> To make values comparable to those from Tatoosh, a trip value at Pt Grenville is considered the maximum number of eagles sighted over 3-4 consecutive observation days.

<sup>4</sup> Includes observation effort only at Burning Barrel Point, from which eagles are readily observed and aged.



